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ELK POPULATION DYNAMICS AND BREEDING BIOLOGY

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JOB PROGRESS REPORT
RESEARCH PROJECT

State: Montana

Project No: W-120-R-18 Project Title: Statewide Wildlife Research

Program No.: I Program Title: Big Game Research

Study No.: BG-3.1 Study Title: Elk Ecology Studies

Job No.: 1 Job Title: Elk Population Dynamics and Breeding Biology

Period Covered: July 1, 1986 - June 30, 1987

Prepared by: Terry N. Lonner
Terry N. Lonner

Philip Schladweiler
Philip Schladweiler

Approved By: John P. Weigand

Arnold Olsen

Date: Sept. 14, 1987

Since this is a Progress Report only, results presented herein are not necessarily final and may be subject to change. For this reason, the information contained in this report may not be published or used for other purposes without permission of the director.

OBJECTIVE

Assist with the compilation and evaluation of existing data bases on several elk herds in Montana and to coordinate and recommend research and management studies and procedures which will provide for more effective management and a better understanding of elk population dynamics as affected by various hunting strategies.

METHODS

Published and unpublished data continued to be compiled and evaluated on this subject. Meetings with Department biologists, wildlife managers and planners were conducted to obtain their viewpoints and knowledge. This information will continue to be synthesized with the aid of the computer programs POSIM (Mooney and Lonner 1978) and TELDAY (Wildlfe Div., MDFWP 1986) to better organize existing data bases and for an evaluation of elk management in Montana with suggested improvements.

RESULTS AND DISCUSSION

Coordination with Montana Dept. of Fish, Wildlife and Parks' biologists and game managers was continued to address future management and research needs for elk.

It was decided in 1984 (Lonner and Schladweiler 1984) that one area within each of the six Montana Dept. of Fish, Wildlife and Parks' regions where most of the elk hunting in Montana occurs will be used to intensively evaluate past and current elk management activities. These areas were selected based on good historical elk management information dating back to at least 1970 and their importance for elk hunting.

Elk population data continues to be gathered from each of these areas and will be used to develop a population dynamics model for each area. This analysis will be used as a base to evaluate the effects of future elk habitat and hunting season changes within each area. Evaluations of elk management in each of these areas will be compared to one another with additional comparisons to the results of past and current elk research efforts.

RECOMMENDATIONS

This aspect of the overall study should be continued in accordance with the objectives and methods as stated in the 1988-1992 Application for Federal Aid for this research effort.

Literature Cited

Lonner, T. N. and P. Schladweiler. 1984. Elk Study Planning and Coordination. In Statewide Wildlife Research, Region Eight. Unpubl. P-R Job Prog. Rept., Proj. W-120-R-15, Job 1.2 pp.

Mooney, E. L. and T. N. Lonner. 1978. POSIM-A General Wildlife Population Simulator. Pps.631-640. In H. J. Higland, N. R. Neilson and L. G. Hulls Eds.. Proc. 1978 Winter Simulation Conf., Miami, Fl., Dec. 4-6, 1978. 1051 pp.

Wildlife Division. 1986. TELDAY user's manual. Mont. Dept. Fish, Wildl. and Parks, Helena. InPrep.

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INTRODUCTION

Elk management in Montana has been primarily directed toward increasing elk numbers and maintaining a diversity of choice in elk hunting opportunity. However, either-sex elk hunting has decreased substantially from the early 1960s. In 1963, 67% of Montana's hunted elk habitat was open to season-long either-sex hunting; by 1985 this had dropped to 1% (Wildl. Div., MDFWP 1985). Although hunting for antlered bull elk has remained quite liberal, branch-antlered bull only areas have been increasing. In the early 1960s no Montana elk hunting areas were restricted to branch-antlered bulls only for hunters wanting or restricted to the taking of an antlered bull. By 1985, 3% of Montana's elk habitat was restricted to branch-antlered bull hunting. Depending on the area, this restriction resulted from either some hunters wanting a better opportunity to harvest a large or "trophy" bull or the concern over the long term biological affects of yearling bulls siring most of the calves.

Available evidence suggests that low proportions of mature bulls in elk populations might negatively affect calf production and/or survival and population size (Hines and Lemos 1979, Prothero et al. 1979, and Smith 1980). Low observed calf:cow ratios in the Gravelly Mountains during the winters of 1979-80 and 1980-81 (18-35 calves/100 cows versus 55-68/100 during 1970-75, Chrest and Herbert 1980, 1981) coincided with low antlered bull/cow ratios. Concern over these ratios resulted in changes in hunting regulations in hunting district 324 during 1981. The early archery season was eliminated, and the kill during the general elk season was limited to branch-antlered bulls. The branch-antlered bull regulation was implemented in several adjacent hunting districts in subsequent years.

This study was initiated in January, 1984, to assess the role and importance of various hunting strategies and differing kinds and levels of hunting pressure on elk population characteristics and dynamics. Emphasis has been and will continue to be directed toward breeding biology, reproductive success and calf recruitment, and seasonal distribution, movements, and habitat use of adult males and females.

OBJECTIVES

1. Determine the effects of alternate hunting strategies and various harvest rates on elk population dynamics and habitat use due to the steady increase of hunting pressure and loss of habitat security.

2. Test the hypothesis that when mature bulls (2-1/2+ years) make up less than 5% of an elk population during the breeding season, the net reproductive success will be less compared to when the population has greater than 5% mature bulls.

3. Assist biologists with evaluation of existing elk population data and utilize the results from this study as they become available to better manage and understand the effects of various harvest rates and hunting season types on elk population dynamics.

STUDY AREA

Because of low observed calf/cow and mature bull/cow ratios, the popularity of the area for hunting, and the changes in hunting regulations already in place, the Gravelly - Snowcrest Mountains in southwestern Montana were selected as the primary study area. In 1984 and 1985 work was concentrated on the elk which winter on the Madison-Wall Creek Game Range south of Ennis. The physiography and vegetation of this area have been described by Eustace (1967). In 1986, work was expanded to include the elk that winter on the Blacktail Game

Range southeast of Dillon. The study area primarily involves MDFWP hunting districts 322, 323, 324, 325, 326, 327 and 330 (Fig. 1).

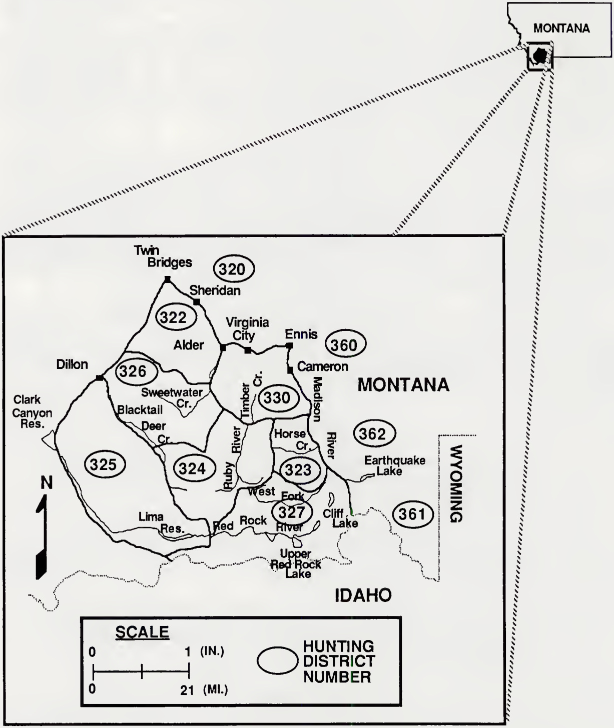


Figure 1. General location and relative position of hunting districts within the Gravelly-Snowcrest Study Area.

METHODS

Methods employed were the same as previously reported (Lonner and Schladweiler 1986) with the following exceptions: 1) neonatal calves were captured by hand while searching for them from horseback near the Blacktail Game Range and in the West Fork of the Madison drainage; 2) hunter check stations were consolidated and operated at 3 primary locations on weekends during the general rifle season, including a new check station on the East Fork of the Blacktail Road; 3) a better collar material was used on the newborn calf radio collars - a nonelastic nylon webbing was folded and pleated so it would expand from about 30 to 75 cm; 4) summer elk classifications were made from a helicopter; 5) elk were continued to be aged by the mandibular dentition technique as described by Quimby and Gaab, 1957; and 6) attempts to determine pregnancy using serum progesterone levels have been discontinued because of the relative lack of accuracy when compared to other methods (see Lonner and Schladweiler 1986).

RESULTS AND DISCUSSION

Elk Capture and Handling

Drive netting resulted in the capture and handling of 30 elk on 20 March, 1987 on the Blacktail Game Range, including 1 recapture. The recaptured animal was a yearling cow which had been neckbanded on the Blacktail Game Range the previous winter. She was pregnancy tested and a blood sample was taken before she was released. Sex and age of all animals captured during drive netting are shown in Table 1, along with the number of each group which were radio collared.

In a continued effort to determine early calf mortality and track individual elk for their entire life, 9 additional newborn calves were captured and fitted with radios and ear tags between 3-10 June, 1987. General information for each individual elk handled in 1987 appears in Table 2.

Table 1. Sex and age class of all elk captured and released, and those radio-collared, on the Blacktail Game Range, March 1987.

Total caught and number radio-collared (in parentheses) by age class.

	Age Class					
	calves	1 1/2	2 1/2	3 1/2-5 1/2	6 1/2-8 1/2	9 1/2+
Males	3 (3)	2 (2)	0	0	0	0
Females	4 (3)	8 (7)	0	11 (9)	2 (2)	0
Total	7 (6)	10 (9)	0	11 (9)	2 (2)	0

Table 2. General information from 39 elk handled on or near the Blacktail Game Range during March and June 1987.

Id No.	Month	Day	Year	Location	Sex[a]	Age
00187	06	03	87	Basin Cr.	1	0.1
00287	06	05	87	Long Cr.	1	0.1
00387	06	09	87	W. Fk. Madison R.	1	0.1
10187	03	20	87	Blacktail G. R.	1	0.5
10287	03	20	87	Blacktail G. R.	1	0.5
10387	03	20	87	Blacktail G. R.	1	0.5
20187	03	20	87	Blacktail G. R.	1	1.5
20287	03	20	87	Blacktail G. R.	1	1.5
50187	06	04	87	Crow Cr.	2	0.1
50287	06	05	87	Long Cr.	2	0.1
50387	06	05	87	Long Cr.	2	0.1
50487	06	08	87	Teepee Cr.	2	0.1
50587	06	08	87	Moss Cr.	2	0.1
50687	06	09	87	W. Fk. Madison R.	2	0.1
60187	03	20	87	Blacktail G. R.	2	0.5
60287	03	20	87	Blacktail G. R.	2	0.5
60387	03	20	87	Blacktail G. R.	2	0.5
60487	03	20	87	Blacktail G. R.	2	0.5
70187	03	20	87	Blacktail G. R.	2	1.5
70287	03	20	87	Blacktail G. R.	2	1.5
70387	03	20	87	Blacktail G. R.	2	1.5
70487	03	20	87	Blacktail G. R.	2	1.5
70587	03	20	87	Blacktail G. R.	2	1.5
70687	03	20	87	Blacktail G. R.	2	1.5
70787	03	20	87	Blacktail G. R.	2	1.5
60186	03	20	87	Blacktail G. R.	2	1.5
90187	03	20	87	Blacktail G. R.	2	3.5
90287	03	20	87	Blacktail G. R.	2	3.5
90387	03	20	87	Blacktail G. R.	2	3.5
90487	03	20	87	Blacktail G. R.	2	3.5
90587	03	20	87	Blacktail G. R.	2	3.5
90687	03	20	87	Blacktail G. R.	2	3.5
90787	03	20	87	Blacktail G. R.	2	3.5
90887	03	20	87	Blacktail G. R.	2	3.5
90987	03	20	87	Blacktail G. R.	2	3.5
91087	03	20	87	Blacktail G. R.	2	4.5
91187	03	20	87	Blacktail G. R.	2	4.5
91287	03	20	87	Blacktail G. R.	2	6.5
91387	03	20	87	Blacktail G. R.	2	7.5

[a] 1=Male, 2=Female

Fate of radio collared neonatal calves

Twenty newborn calves were captured and radio-collared in 1984, 8 in 1985, 20 in 1986 and 9 in 1987. Additional neonates captured in 1986 and 1987 which were ear-tagged only, included 1 elk, 1 moose, and 4 mule deer; their current status is unknown.

Nine of the 57 radio-collared neonate elk died within 2 weeks of their capture, 2 each in 1984, 1985, and 1986, and 3 in 1987. Necropsies indicated that 7 died due to starvation, while 2 died of apparent predation, 1 in 1985 and 1 in 1987. Predator losses included 1 definite and 1 probable black bear kill.

Six of the 7 starvation victims were apparently abandoned by their mothers following handling. The remaining animal, marked in 1987, was found moribund within 30 hours of its capture, with the mother still in attendance. No injuries were noted upon necropsy, and bacterial growth did not occur in cultures of lung and spleen. Based on these data and values for blood parameters, this calf was not receiving adequate nutrition at the time of its capture.

Status of the remaining radio-collared neonates is briefly outlined below by cohort.

1984 - Nine 1984 neonates had radios which quit between late September 1984 and mid-March 1985. All were alive when their radios quit. Two of these animals were subsequently shot by hunters in fall 1985. A third, recaptured and neckbanded in late February 1985, was shot by an archer in Idaho in September 1986.

The remaining 9 animals in this group shed their radios between late June 1984 and early June 1985. All were alive when their radios were shed, and all radios were recovered. Three of these animals were subsequently shot by hunters in fall 1986. This leaves 12 radioed animals in this cohort whose current status is unknown.

1985 - Six 1985 neonates were alive when they shed their radios (N=2) in late June 1985, or their radios quit (N=4) between mid-January 1986 and mid-January 1987. The current status of these 6 animals is unknown.

1986 - Eleven calves radio-collared in 1986 were carrying functioning radios at the end of the report period, while another was shot by a hunter in fall 1986. Radios on the remaining 6 animals either quit (N=5) or were shed (N=1) between mid-July 1986 and mid-March 1987. All were alive when contact was lost, but their current status is unknown.

1987 - Five of the 6 remaining calves had functioning radios and were alive at the end of the report period. The radio on the other calf, which was an experimental solar powered ear tag type of a transmitter, apparently malfunctioned because it has not been contacted since being released.

Blood Tests and Pregnancy Determinations

Blood samples were obtained from all animals caught in 1987. Results of blood tests from all animals handled since 1984 are being analyzed in an attempt to establish normal hematological values. If these normal values can be established, this may help wildlife managers identify causes of high mortality or low productivity when they occur.

Three different methods of determining pregnancy have been used during this study, including 2 utilizing different blood parameters. These include determination of serum progesterone levels, and protein *B* levels (Sasser et al. 1986), plus use of an ultra sound pregnancy tester. Prior to 1987 all 3 methods were employed on most yearling and older cows.

Protein *B* level in blood appears to be the most accurate of the 3 methods of determining pregnancy which we used. This method was employed on 194 animals between 1984 and 1987. Included were 60 calves (40 females and 20 males), 15 yearling males, and 119 cows (28 yearlings and 91 adults). Overall, 2 apparent errors and 4 questionable (indeterminate) results were obtained using this method. The questionable results involved 1 female calf, 1 yearling male, and 2 yearling females; all were open (nonpregnant) based on 1 or both of the other methods used. Apparent errors included a yearling cow called open but which both other methods determined to be pregnant, and an adult cow called pregnant but which was open according to both other methods.

The ultra sound pregnancy tester has been used on 32 calves (29 females and 3 males) and 135 cows (31 yearlings and 104 adults) thus far. The 167 animals checked for pregnancy by this method included 7 apparent errors and 2 with questionable results. The latter were obtained from a yearling cow which both other methods called open, and an adult cow called pregnant by both other methods. The 7 apparent errors included 4 yearling and 3 adult cows. One yearling called pregnant by this method was open according to both other methods.The pregnancy tester called the remaining 6 animals open, while 1 or both of the other 2 methods found them to be pregnant. At least one of the latter was observed to have a calf later in the same year, confirming the error of this method and verifying the accuracy of the other 2. This method should continue to be used as a potential check on protein *B*, or as a backup in case a blood sample is not obtained or is lost.

Pregnancy determinations made in 1987 included 8 yearling and 13 adult cows on which the ultra sound pregnancy tester was used and/or whose blood was checked for protein *B*. Five of the 8 yearlings and all adults were determined to be pregnant.

Pregnancy rates of various age classes of females tested between 1984 and 1987 are shown in Fig. 2. To date, there does not appear to be a low pregnancy rate in the herds wintering on either the Madison-Wall Cr. or Blacktail Game Ranges.

Blood samples from most animals handled to date have been tested for antibodies against brucellosis (N=271), bluetongue (N=272), anaplasmosis (N=269), and leptospirosis (N=269). All tests for brucellosis and bluetongue have been negative. All elk from the Madison-Wall Cr. area tested negative for leptospirosis. Fourteen elk from the Blacktail Game Range tested seropositive for leptospirosis in 1986 and 1987. Little is known about the immunologic features of this disease in wild mammals (Shotts 1981). More tests have to be done to understand what these results mean, but it may simply indicate that the elk have been exposed to the disease and have developed antigens against it (Dr. Bill Quinn, personal communication). Seven elk from this game range also had suspect reactions to anaplasmosis while tests from the Madison-Wall Creek elk showed 6 positive and 3 suspect reactions to anaplasmosis.

The complement-fixation test used to diagnose anaplasmosis in cattle results in a high incidence of false positive tests when applied to wildlife species (Howe et al. 1964, Howe and Hepworth 1965, Vaughn et al. 1973, Jacobson et al. 1977). Howe et al. (1964) and Vaughn et al. (1973) reported that 55% and 60%, respectively, of the elk they sampled gave false positive or suspect reactions. However, Howe et al. (1964) were unable to experimentally transmit anaplasmosis from these elk to calves or sheep. These studies suggest that our positive and suspect reactors were the result of the diagnostic test's limitations rather than representing infected animals.

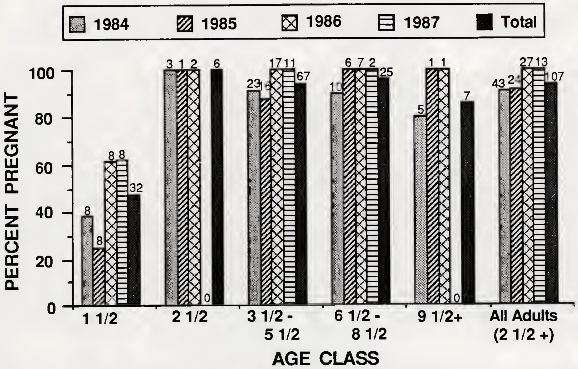


Figure 2. Pregnancy rate of yearling and older cow elk captured on or near the Madison-Wall Creek (1984-1985) and Blacktail (1986-1987) Game Ranges. Numbers above bars indicate sample size.

Elk Distribution

The distribution of 138 elk marked on or near the Madison-Wall Creek Game Range during the winters of 1983-84 and 1984-85 and of 49 elk marked on the Blacktail Game Range during the winter of 1985-86 were plotted and a herd home range calculated for the continuous time periods March 29, 1984 to June 25, 1987 and March 4, 1986 to June 25, 1987, respectively. The computer program TELDAY (Wildlife Div., MDFWP 1986) was used for plotting and calculations. Most of these relocations were from radio marked elk and included capture sites. Marked neonates were not used in this analysis, since some of these may have been from cows not wintering on or near these two game ranges.

One thousand eight hundred and three relocations of marked elk from the Madison-Wall Creek Game Range have been found distributed over an area of 7,420 km^2 (2,864 mi^2) with an elevational range of 5,500 to 10,000 feet and an average of 7,300 feet (Fig. 3). A few relocations were excluded from these elk, since they were from young elk that dispersed well into Idaho.These same figures for 450 relocations of marked elk from the Blacktail Game Range are 4,457 km^2 (1,720 mi^2), 6,600 to 9,400 feet and an average of 7,700 feet, respectively (Fig. 4). The overall home range of all elk marked on these two winter ranges, including relocations from dispersers, involved 2,260 relocations that were distributed over an area of 13,970 km^2 (5,393 mi^2).

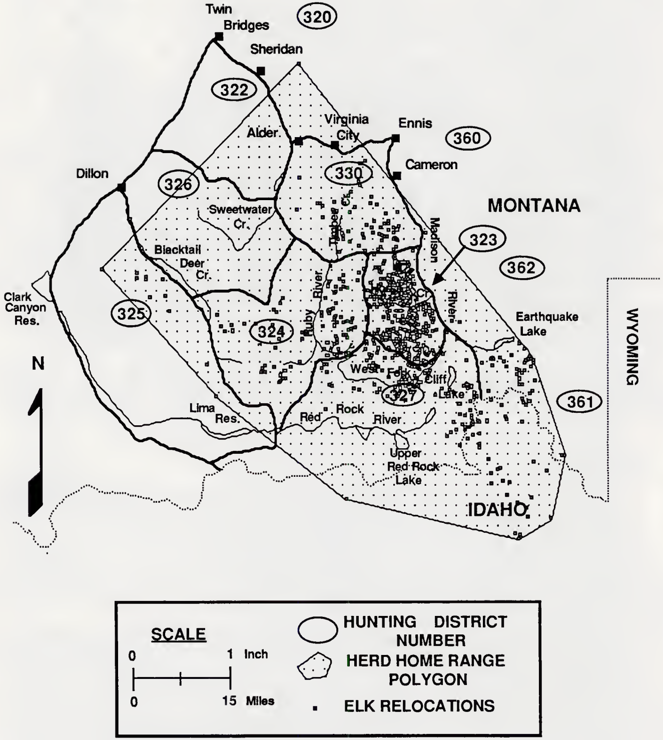


Figure 3. Relocations and herd home range polygon from 138 elk marked on or near the Madison-Wall Creek Game Range and tracked from late March, 1984 through June, 1987.

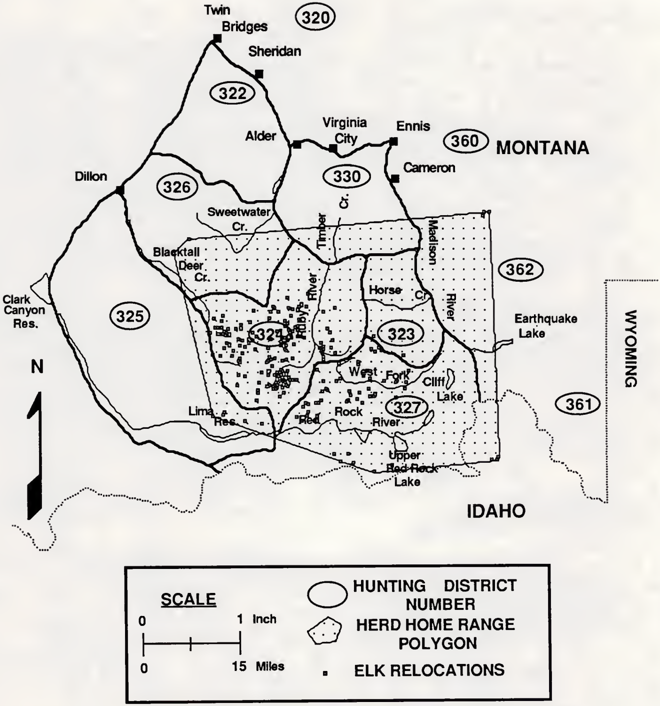


Figure 4. Relocations and herd home range polygon from 49 elk marked on the Blacktail Game Range and tracked from early March, 1986 through June, 1987.

Relocations by Hunting District

The distribution of relocations from these two wintering areas and for five time periods was tallied by hunting district. The time periods are winter (December 1 to February 28), spring (March 1 to May 31), summer (June 1 to August 31), fall (September 1 to November 30) and total (from the beginning of the study to the end of this report period). The results are illustrated in Figs. 5 & 6. Relocations from the Madison-Wall Cr. elk predominantly occurred in Hunting District 323 and ranged from 61% during summer to 85% during spring, while relocations from Blacktail elk predominantly occurred in Hunting District 324 and ranged from 62% during summer to 98% during winter. Seventy two percent of the total relocations from the Madison-Wall Cr. area occurred in Hunting District 323, while 80% of the total from the Blacktail area occurred in district 324. The second and third most important hunting districts by time period for Madison-Wall Cr. elk were: winter - 330 (9%) and 324 (6%); spring - 330 (4%) and 327 (4%); summer - 327 (21%) and 324 (7%); fall - 327 (12%) and 324 (10%); and continuous - 327 (10%) and 324 (6%). These figures for Blacktail elk were: winter - 327 (2%) (there were no relocations in a third Hunting District for this time period); spring - 327 (6%) and 325 (1%); summer - 327 (29%) and 325 (5%); fall - 327 (24%) and 360 (4%); and continuous - 327 (15%) and 325 (2%).

Elk Census and Classifications

Census flights resulted in total counts of 2,908, 3,037, and 4,332 for the winters of 1984-85, 1985-86, and 1986-87, respectively. General locations where elk were observed and counted are presented in Table 3. The higher 1986-87 count, compared to the previous 2 winters, was the result of excellent observing conditions, not a major population increase.

Table 3. General locations of elk observations and counts for the winters of 1984-85, 1985-86, and 1986-87.

	1984-85	1985-86	1986-87
Axolotl Lake Area	33	97	80
Cherry-Morgan Creeks Area	414	150	623
Madison-Wall Creek Game Range	664	805	1,233
Missouri Flats	---[a]	35	134
Total for east side of Gravellys	1,111	1,087	2,070
Centennial Valley	57	19	62
Blacktail Game Range & Robb-Ledford Creeks Area	1,740	1,416	1,403
Greenhorn Mtns. & Lower Ruby River	---	323	432
Little Sage - Basin Creeks Area	---	199	365
Total for Blacktail-Centennial- Greenhorn Area	1,797	1,957	2,262
Grand Total	2,908	3,044	4,332

[a] No flights over this area were made.

Elk were classified whenever possible to determine the percentage of calves present, and to note changes in the proportion of calves which would indicate the timing or extent of calf mortality. All classifications were made in hunting districts 323, 324, 327, and/or 330.

Summer 1986 classifications included 1,693 and 1,050 animals classified in July using fixed-wing aircraft and a helicopter, respectively, and 163 classified from the ground in late June.

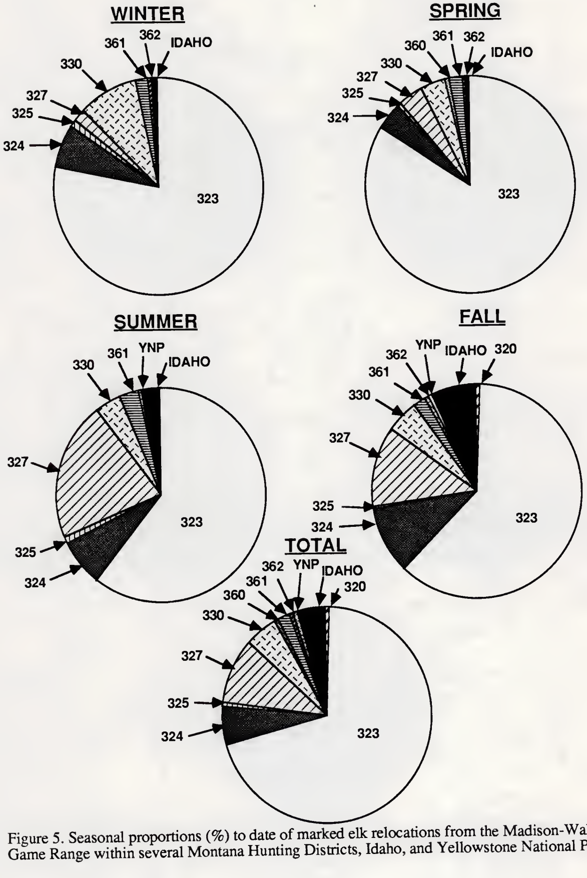
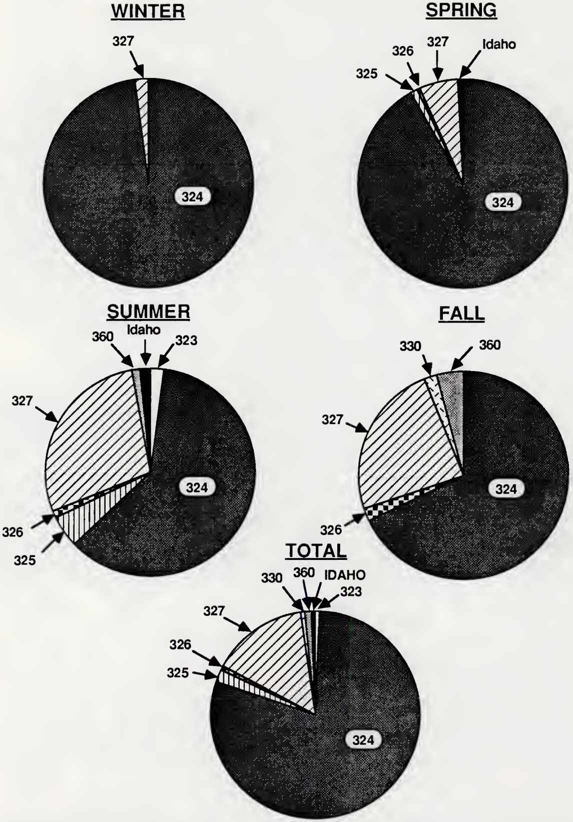


Figure 5. Seasonal proportions (%) to date of marked elk relocations from the Madison-Wall Creek Game Range within several Montana Hunting Districts, Idaho, and Yellowstone National Park.


WINTER

SPRING

SUMMER

FALL

TOTAL

Figure 6. Seasonal proportions (%) to date of marked elk relocations from the Blacktail Game Range within several Montana Hunting Districts and Idaho.

Because of their short antlers, some yearling bulls cannot be reliably distinguished from cows during early summer except under the most favorable conditions. Therefore, ratios of calves:100 cows + spikes are used for these observations. These ratios were 49.0, 35.6, and 49.6 calves:100 cows + spikes for ground, fixed-wing, and helicopter classifications, respectively. Calves comprised 31, 26, and 33 percent, and branch-antlered bulls 5, 2, and 2 percent of the total for each respective data set. Data from 1986 are compared with those from previous years in Table 4 . The lower proportion of calves noted on the fixed-wing flight may be the result of missing some calves which were bedded or obscured by larger elk.

Table 4. Comparison of classification data between the summers of 1984, 1985, and 1986 for the Gravelly-Snowcrest Mountains. (BABS = Branch-Antlered Bulls)

	From the Air (July)			From the Ground		
	Calves/100 Cows +Spikes	Percent Calves	Percent BABS	Calves/100 Cows + Spikes	Percent Calves	Percent BABS
1986(FW)[a]	35.6	26	2	---	--	-
1986(H)	49.6	33	2	49.0	31	5
1985(FW)	49.7	32	3	41.5	27	7
1984(H)	44.3	30	2	43.5	30	2

[a] FW = fixed wing, H = helicopter

Winter 1986-87 classifications conducted on the Madison-Wall Creek and Blacktail Game Ranges are shown in Table 5. In general, the resulting calf:cow ratios and proportions of antlered bulls were similar on both areas. The percentage of branch-antlered bulls was somewhat lower on the Blacktail Game Range versus the Madison-Wall Creek Game Range. This probably results from a higher proportion of Blacktail elk being in areas open to any bull hunting during fall than are those from Madison-Wall Creek.

Based on elk classifications made during this report period, good calf production and survival is indicated for elk wintering on both the Blacktail and Madison-Wall Creek Game Ranges.

Mortality of marked animals

Known fate of marked neonatal calves has already been discussed. Twenty-one of 74 (28%) elk marked in late March, 1984, were known to be dead as of mid-May 1987. These included a female calf found dead in a fence approximately 1 month after marking, 19 taken by hunters (8, 8, and 3 in 1984, 1985, and 1986, respectively), and an adult female that apparently died of natural causes in late spring 1985. The 1985 hunting season mortalities included 1 cow which was apparently a crippling loss.

Eleven of 67 (16%) elk marked in February, 1985, were known dead by mid-May 1987. These included a yearling bull which died of natural causes in summer, 1985, and 10 taken by hunters (3 in 1985 and 7 in 1986). One hunting season mortality in each year was an apparent crippling loss. In addition, 2 female calves are known to have shed their collars, and a third animal which dispersed well into Idaho in 1985 either died or shed its collar there.

Table 5. Classification results from ground observations of elk on the Madison-Wall Creek and Blacktail Creek Game Ranges during the winter of 1986-87.

Date	Total	Cows	Calves	Spikes	BABS	Calf/Cow Ratio	Percent AB[a]	Percent BAB[b]
				GROUND				
				Madison - Wall Creek Game Range				
1/8[c]	900	499	322	65	14	64/100	9	1.6
3/12[c]	714	434	230	46	4	53/100	7	0.6
4/10	160	91	39	28	2	43/100	19	1.2
4/20	161	102	51	8	0	50/100	5	0.0
				Blacktail Game Range				
3/1	506	295	144	62	5	58/100	13	1.0
3/2	495	254	132	99	10	52/100	22	2.0
4/2	190	111	70	9	0	63/100	5	0.0
4/2[c]	528	317	171	35	5	54/100	8	0.9
4/3[c]	631	379	233	18	1	62/100	3	0.2
				AIR				
2/26[d]	1651	1556		79	16	--	6	1.0

[a] percent of sample antlered bulls

[b] percent of sample branch-antlered bulls

[c] best all around classifications with good sample size

[d] this is a partial classification from a super cub flight where a total of 4,332 elk were counted in the entire Gravelly-Snowcrest area, calves were not counted separate from cows

Ten 1986 hunter kills were recorded from the 49 animals (20%) marked the previous March. No other known mortalities were recorded for this group.

In 1984, 1985, and 1986 there were 8, 8, and 4 bull calves marked, respectively. Four of the eight bull calves marked in 1984 were killed by hunters, while the status of the other 4 is unknown. Four of the 8 bull calves marked in 1985 were killed by hunters, 1 was an apparent crippling loss and died on the winter range in early winter 1986-1987, 1 was killed by a natural predator, and the status of the remaining 2 is unknown. One of the bull calves marked in 1986 was killed by a hunter, 2 were alive during the 1986-87 winter, and one was last located on Oct. 10, 1986.

There were 6, 5, and 5 males marked as yearlings in 1984, 1985, and 1986, respectively. Three of the 6 marked in 1984 were shot during the 1984 hunting season, 2 were shot during the 1985 hunting season and the status of the remaining one is unknown. One of the 5 marked in 1985 was shot during the 1985 hunting season, one was shot during the 1986 hunting season and the status of the remaining 3 is unknown. All five of the yearling bulls marked in 1986 were shot during the fall of 1986. Since the beginning of the study, only one bull was marked when branch-antlered (a 2 1/2 year old). This was done on the Madison-Wall Cr. Game Range in March, 1984 and he was shot during the 1985 hunting season.

Check Station Results

Hunter check stations were operated at 3 locations during the 1986 hunting season. The check stations operated on the east side of the Gravellys during the hunting seasons in 1984 and 1985 were consolidated into one check station operated on highway 287 on the eastern edge of Ennis. The check station on the Ruby Road was again operated and an additional check station was operated about 10 miles from Dillon on the East Fork of the Blacktail Road. Check stations were operated the first 2 days of the season (Sunday and Monday) and each weekend thereafter from mid morning until approximately 1 hour after dark, depending on the amount of traffic. These check stations intercept hunters from Hunting Districts 323, 324, 325, 326, 327, and 330 or a combination of these districts. A few hunters from these hunting units were also checked by the Gallatin Check Station operated in the Gallatin Canyon. Results obtained from these check stations for the 1986 hunting season are presented by weekend and hunting district in Table 6. A few animals checked in the field are not included in Table 6 because the lack of corresponding hunter effort would tend to bias the results.

During the 1986 hunting season a little over 5,200 hunters were checked, spent over 9,900 days hunting and bagged 255 elk. These figures for 1984 and 1985 were 3,400, 6,000, 173, and 3,200, 6,800, and 225, respectively. Most hunters, effort, and elk checked were from hunting district 324 for all years.

An average of 42% of the hunters were checked during the first two weekends of the general hunting season in 1984-1986 (41% in 1984, 47% in 1985, and 40% in 1986) (Fig. 7). Hunter effort was also skewed toward these 2 weekends with an average of 40% of the season long hunter days expended during this time (39% in 1984 and 1986, and 43% in 1985). Correspondingly, an average of 50% of the season-long elk harvest also occurred during these two weekends (47% in 1984, 56% in 1985, and 45% in 1986). Elk seen per hunter day was highest opening weekend and hunter days per elk killed was lowest (Figs. 8 & 9).

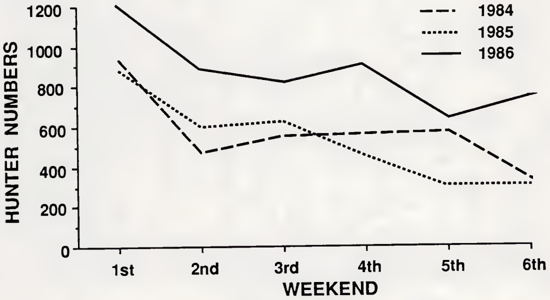


Figure 7. Hunter numbers by weekend from data recorded at check stations during the 1984, 1985, and 1986 big game hunting seasons in the Gravelly Mountains and vicinity.

Table 6. A summary of elk hunting statistics from 3 check stations operated in the Gravelly-Snowcrest Mountains during the general hunting season in 1986.

		HUNTERS CHECKED				ELK OBSERVED			ELK CHECKED		
Date	Hunting District	Total	Number of Parties	Hunters per Party	Hunter days Effort	Percent of Parties Observing Elk	Elk Observed per Hunter	Elk Observed per Hunter Day	Total	Elk per Hunter	Hunter Days per Elk
26-27 Oct.	322	----	-----	-.--	----	---	-.-	-.-	---	-.-----	---.--
	323	122	49	2.5	171	49	1.6	1.1	5	0.041	34.2
	324	611	263	2.3	815	68	9.6	7.2	43	0.070	19.0
	325	102	51	2.0	119	20	0.7	0.6	1	0.010	119.0
	326	76	31	2.5	87	10	1.4	1.3	1	0.013	87.0
	327	151	59	2.6	237	73	2.4	1.5	13	0.086	18.2
	330	145	57	2.5	179	44	2.9	2.4	8	0.055	22.4
	323-27	----	-----	-.-	----	---	-.-	-.-	---	-.-----	---.--
	323-30	3	1	3.0	3	0	0.0	0.0	0	0.0	0.0
Weekend Total		1210	511	2.4	1611	56	5.8	4.3	71	0.059	22.7
1-2 Nov.	322	2	1	2.0	14	0	0.0	0.0	0	0.0	0.0
	323	98	41	2.4	265	41	2.6	0.9	12	0.122	22.1
	324	442	179	2.5	1240	51	10.1	3.6	20	0.045	62.0
	325	66	24	2.7	80	17	0.6	0.5	1	0.015	80.0
	326	52	26	2.0	63	8	0.4	0.3	0	0.0	0.0
	327	44	17	2.6	209	53	5.1	1.1	8	0.182	26.1
	330	151	54	2.8	314	39	1.3	0.6	4	0.026	78.5
	323-27	4	2	2.0	15	100	15.2	4.1	0	0.0	0.0
	323-30	27	11	2.5	68	45	1.7	0.7	0	0.0	0.0
Weekend Total		886	355	2.5	2267	43	6.0	2.3	45	0.051	50.4
8-9 Nov.	322	5	1	5.0	5	0	0.0	0.0	0	0.0	0.0
	323	91	39	2.3	182	36	3.0	1.5	4	0.044	45.5
	324	464	188	2.5	999	42	3.0	1.4	34	0.073	29.4
	325	58	21	2.8	67	38	0.7	0.6	3	0.052	22.3
	326	62	28	2.2	62	0	0.0	0.0	0	0.0	0.0
	327	47	21	2.2	109	24	0.7	0.3	0	0.0	0.0
	330	65	26	2.5	119	15	0.7	0.4	3	0.046	39.7
	323-27	10	4	2.5	16	25	0.3	0.2	0	0.0	0.0
	323-30	18	8	2.2	38	50	0.4	0.2	0	0.0	0.0
Weekend Total		820	336	2.4	1596	34	2.2	1.1	44	0.054	36.3
1st 1/2 Season	322	7	2	3.5	19	0	0.0	0.0	0	0.0	0.0
	323	311	129	2.4	617	43	2.3	1.2	21	0.068	29.4
	324	1517	630	2.4	3054	56	7.7	3.8	97	0.064	31.5
	325	226	96	2.4	266	23	0.7	0.6	5	0.022	53.2
	326	190	85	2.2	212	6	0.7	0.6	1	0.005	212.0
	327	242	97	2.5	555	59	2.5	1.1	21	0.087	26.4
	330	361	137	2.6	612	36	1.8	1.1	15	0.042	40.8
	323-27	14	6	2.3	31	50	4.6	2.1	0	0.0	0.0
	323-30	48	20	2.4	108	45	1.1	0.5	0	0.0	0.0
1st 1/2 Season	Total	2916	1202	2.4	5473	46	4.8	2.6	160	0.055	34.2

Table 6. Continued.

		HUNTERS CHECKED				ELK OBSERVED			ELK CHECKED		
Date	Hunting District	Total	Number of Parties	Hunters per Party	Hunter days Effort	Percent of Parties Observing Elk	Elk Observed per Hunter	Elk Observed per Hunter Day	Total	Elk per Hunter	Hunter Days per Elk
15-16 Nov.	322	----	-----	-.-	----	---	-.-	-.-	---	-.-----	---.--
	323	88	36	2.4	153	33	2.6	1.5	6	0.068	25.5
	324	412	166	2.5	591	45	4.3	3.0	18	0.044	32.8
	325	80	34	2.4	83	18	1.5	1.4	3	0.037	27.7
	326	165	62	2.7	164	5	0.1	0.1	0	0.0	0.0
	327	57	19	3.0	149	47	3.7	1.4	7	0.123	21.3
	330	106	39	2.7	246	23	3.1	1.3	4	0.038	61.5
	323-27	----	-----	-.-	----	---	-.-	-.-	---	-.-----	---.--
	323-30	4	2	2.0	2	50	0.5	1.0	0	0.0	0.0
Weekend Total		912	358	2.5	1387	32	2.9	1.9	38	0.042	36.5
22-23 Nov.	322	----	-----	-.-	----	---	-.-	-.-	---	-.-----	---.--
	323	66	25	2.6	133	44	4.7	2.3	3	0.045	44.3
	324	252	94	2.7	568	40	8.3	3.7	21	0.083	27.0
	325	55	27	2.0	55	19	1.3	1.3	2	0.036	27.5
	326	66	32	2.1	67	0	0.0	0.0	0	0.0	0.0
	327	36	13	2.8	70	62	5.6	2.9	1	0.028	70.0
	330	140	58	2.6	318	40	7.5	3.5	7	0.047	45.4
	323-27	4	2	2.0	6	0	0.0	0.0	0	0.0	0.0
	323-30	12	6	2.0	12	67	24.8	24.8	0	0.0	0.0
Weekend Total		639	257	2.5	1228	35	6.4	3.3	34	0.053	36.1
29-30 Nov.	322	----	-----	-.-	----	---	-.-	-.-	---	-.-----	---.--
	323	91	36	2.5	310	42	3.6	1.1	3	0.033	103.3
	324	264	106	2.5	655	44	7.1	2.9	5	0.019	131.0
	325	100	39	2.6	149	21	1.4	0.9	3	0.030	49.7
	326	122	51	2.4	137	6	0.1	0.1	0	0.0	0.0
	327	44	15	2.9	132	47	9.5	3.2	6	0.136	22.0
	330	114	44	2.6	389	32	1.8	0.5	6	0.053	64.8
	323-27	6	3	2.0	9	33	0.7	0.4	0	0.0	0.0
	323-30	9	3	3.0	36	67	5.9	1.5	0	0.0	0.0
Weekend Total		750	287	2.5	1815	33	4.0	1.7	23	0.031	78.9
2nd 1/2 Season	322	----	-----	-.-	----	---	-.-	-.-	---	-.-----	---.--
	323	245	97	2.5	596	39	3.5	1.5	12	0.049	49.7
	324	928	366	2.5	1813	44	6.2	3.2	44	0.047	41.2
	325	235	100	2.4	287	19	1.4	1.2	8	0.034	35.9
	326	353	145	2.4	367	4	0.1	0.1	0	0.0	0.0
	327	137	47	2.9	350	51	6.1	2.4	14	0.102	25.0
	330	368	141	2.6	953	33	4.5	1.7	17	0.046	56.1
	323-27	10	5	2.0	15	20	0.4	0.3	0	0.0	0.0
	323-30	25	11	2.3	50	64	14.1	7.1	0	0.0	0.0
2nd 1/2 Season Total		2301	912	2.5	4430	33	4.3	2.2	95	0.041	46.6
Season Total	322	7	2	3.5	19	0	0.0	0.0	0	0.0	0.0
	323	556	226	2.5	1213	41	2.9	1.3	33	0.059	36.8
	324	2445	996	2.5	4866	51	7.1	3.6	141	0.058	34.5
	325	461	196	2.4	553	21	1.0	0.9	13	0.028	42.5
	326	543	230	2.4	579	5	0.3	0.3	1	0.002	579.0
	327	379	144	2.6	905	56	3.8	1.6	35	0.092	25.9
	330	729	278	2.6	1565	35	3.2	1.5	32	0.044	48.9
	323-27	24	11	2.2	46	36	2.8	1.5	0	0.0	0.0
	323-30	73	31	2.4	158	52	5.6	2.6	0	0.0	0.0
Total		5217	2114	2.5	9903	40	4.6	2.4	255	0.049	38.8

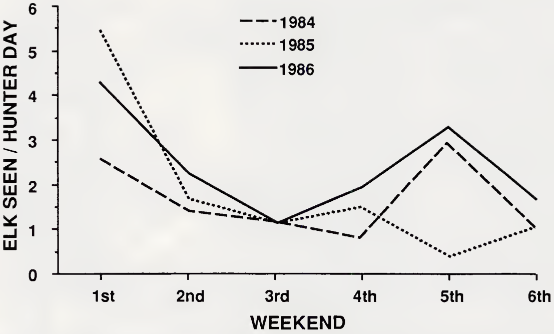


Figure 8. Elk seen per hunter day by weekend from data recorded at check stations during the 1984, 1985, and 1986 big game hunting seasons in the Gravelly Mountains and vicinity.

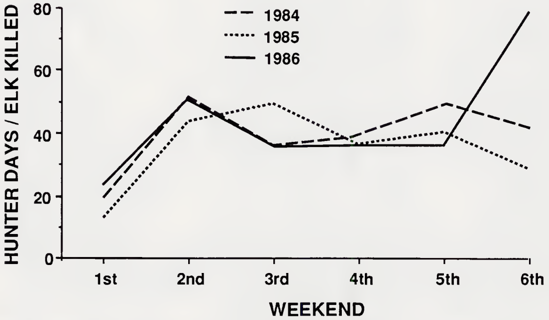


Figure 9. Hunter days per elk killed by weekend from data recorded at check stations during the 1984, 1985, and 1986 big game hunting seasons in the Gravelly Mountains and vicinity.

Statewide harvest survey figures indicate a total harvest of 1,336, 1,234, and 1,050 elk in 1984, 1985, and 1986, respectively from hunting districts 323, 324, 327, and 330. Our check stations checked 173, 225, and 241 elk from these hunting districts in 1984, 1985, and 1986, respectively. Forty, 36, and 46 percent of the total harvest figures from the harvest survey were antlered bulls for 1984, 1985, and 1986, respectively, while these percentages from our check stations were 41, 47, and 46 for these 3 years, respectively.

Harvest survey results showed that the establishment of the branch-antlered bull regulation in hunting district 324 in 1981 resulted in over a 50% reduction of bulls harvested compared to the annual bull harvest during 1977-1980. Although the bull harvest during the second year of this regulation in 324 was similar to the annual harvest during these previous years, there was a trend for it to be inconsistently less again in 1983-1986 (Fig. 10). After this regulation was applied to hunting districts 323, 326, and 330 in 1983, the combined annual bull harvest for these hunting units remained about 30% less during 1983-1986 compared to 1979-1982 (Fig. 10). In hunting districts 325 and 327, where the branch-antlered bull regulation was not applied, the combined bull harvest tended to increase from 1977-1986 (Fig. 11).

Although there was a reduction in the total bull harvest under the branch-antlered bull regulation, the proportion of branch-antlered bulls in the harvest increased substantially compared to when any bull was legal.

The harvest survey indicated that the antlerless harvest in these 4 hunting districts was comprised of nearly 8 cows for every calf in 1984 and 6 cows for every calf in 1985 and 1986, whereas this ratio from our check station figures was 3:1 for all three years. In either case, the differential harvest of cows versus calves would result in a higher post-season calf/cow ratio than was present prior to the hunting season.

Discrepancies were again noted between the two data sets in the number of hunting days per elk bagged in three of these 4 hunting districts. In each of these 3 cases , the check station data gave figures 1.3 to 1.8 times higher than those from the harvest survey in 1986. In 1984 and 1985, check station data gave figures 1.4 to 1.9 and 1.6 to 3.2 times higher, respectively (Lonner and Schladweiler 1986). It is possible that these data from check stations are more accurate, because the time lag between hunting and hunter interviews is much less at check stations than that between hunting and the harvest survey. Remembering the time spent hunting will be easier immediately after the hunt than several weeks later.

Thus far, out of 298 antlered bulls checked in 1984-1986, 18% have been yearling spikes (1 X 1 points) and 82% branch-antlered (2 X 1 points or more). A further breakdown of these bulls is presented in Figure 12. Based on bulls checked through the check stations in all 3 years, it appears that few bulls live beyond 4 1/2 years, even after four to five years of a branch-antlered bull season (Fig. 13).

The age distribution between jaw tag returns and antlerless elk aged at check stations in 1985 and 1986 was similar; differences within an age class were all less than 10% (Figs. 14 & 15). However, the jaw tag aged elk may have been more accurate, since conditions were more optimum for aging this category of elk. A between years comparison of age distribution of antlerless elk in the harvest is presented in Figure 16. Calves were excluded from this analysis, since they are selected against by hunters and would be under-represented in the harvest. The age distribution for 1984 is from check stations only; those from 1985-86 are from combined samples of check station data and jaw tag returns. It was assumed that the age distribution in the harvest was a good index to the actual age distribution within the population during each year.

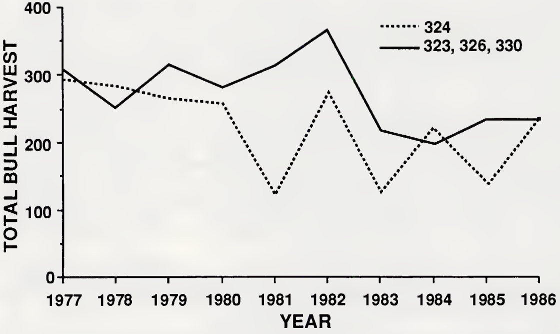


Figure 10. The total bull harvest from harvest survey results for hunting districts 324 and 323, 326, and 330 combined for 1977-1986. Branch-antlered bull reugulations were implemented in 324 during the 1981 hunting season and for 323, 326, and 330 in 1983.

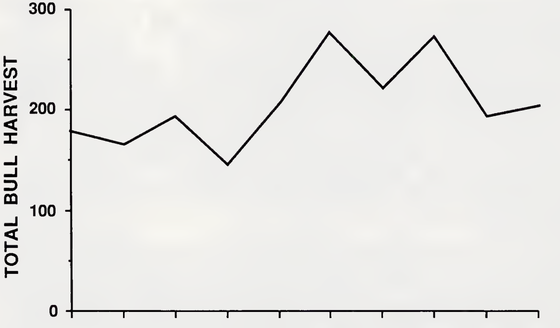


Figure 11. The total bull harvest from harvest survey results for hunting districts 325 and 327 combined for 1977-1986. These hunting districts were open to any antlered bull.

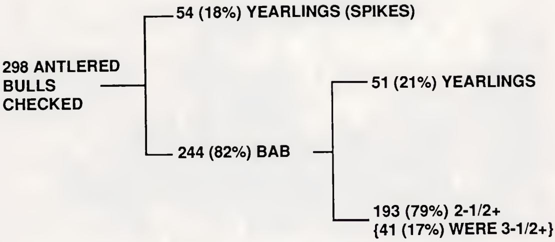


Figure 12. General breakdown of the antlered elk checked in the Gravelly area during the 1984-1986 general hunting seasons. (BAB = branch-antlered bull)

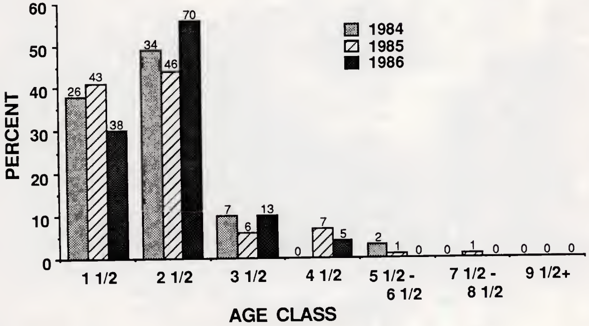


Figure 13. Age class distribution of antlered elk checked in the Gravelly area during the general hunting season in 1984, 1985, and 1986. Numbers above bars indicate sample size.

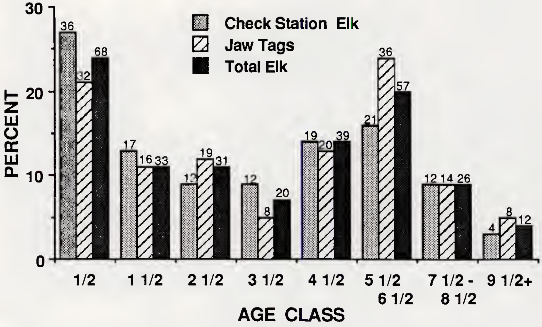


Figure 14. Age class distribution among antlerless elk aged at check stations compared to those aged from jaws turned in by hunters during the 1985 general hunting season in the Gravelly area. Numbers above bars indicate sample size.

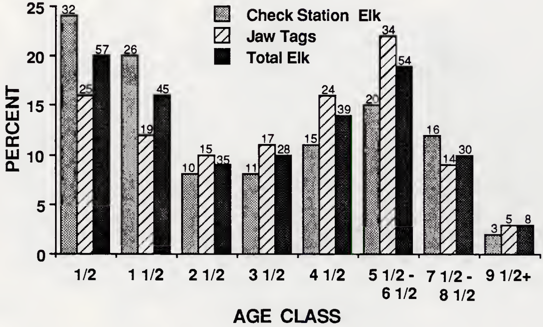


Figure 15. Age class distribution among antlerless elk aged at check stations compared to those aged from jaws turned in by hunters during the 1986 general hunting season in the Gravelly area. Numbers above bars incicate sample size.

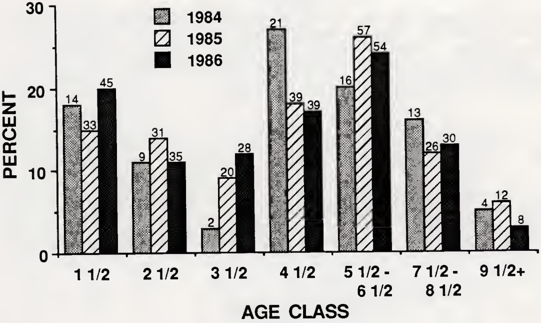


Fig. 16. Age class distribution of antlerless elk checked at check stations in the Gravelly area in 1984 and antlerless elk checked combined with jaw tag returns in 1985 and 1986. Numbers above bars indicate sample size.

Overall, the lowest proportion of antlerless elk occurred in the 9 1/2 and older age class. An elk population with consistent recruitment and mortality should show a diminishing proportion of elk from the youngest to the oldest age classes, so the low proportion of elk in this age class appears normal. However, the second lowest proportion of elk appeared in the 3 1/2 year age class, especially during 1984 and 1985 (Fig. 16). Elk shot in 1984 and 1985 from this age class would have been born in 1981 and 1982, respectively. If this indicated poor recruitment during these years, it should have carried into the harvest of 4 1/2 year olds in 1985 and 1986, which it did not appear to do (Fig. 16). Therefore, the low proportion of harvested elk during 1984 and 1985 in the 3 1/2 year age class may be an anomaly due to sample size, misaging, and/or hunter selectivity bias. Furthermore, the proportion of elk in the 5 1/2-6 1/2 and 7 1/2-8 1/2 year old age classes does not indicate a significant depression in recruitment during the late 1970s.

These data suggest only that recruitment has been consistent since the late 1970s and not the magnitude of recruitment. However, the present post-hunt elk population appears to be similar to that in the early 1980s, despite additional antlerless harvests since 1983.

Elk calves were weighed at check stations as an attempt to evaluate their condition and get an idea as to the approximate times of birth and, hence, conception dates. Thirty-eight calves have thus far been weighed. Eventually these data will be compared to calf weights from other areas. This may give us some indication of the relative conception/birth time and development of calf elk in the Gravellys compared to a population where there is a larger percentage of mature bulls in the herd.

RECOMMENDATIONS

We should continue to mark elk on these two game ranges and, if possible, on other important winter ranges within the study area until about 10% (500 elk) of the overall elk population is marked. These data will help with identification of herd home ranges within the overall study area and establish natality and mortality rates by sex and age class. Neonates associated with these wintering herds should also continue to be captured and instrumented with mortality sensing radio collars.

Analysis of blood samples from all elk captured will be continued. All of these blood samples should continue to be analyzed for disease and general blood chemistry; elk captured during winter will also be analyzed for protein *B* and pregnancy.

Intensive winter and summer classifications should be continued to help measure net recruitment of calves and various age classes of antlered bulls. Hunting mortality data should continue to be collected via check stations and jaw collections. These data will help us better understand elk population dynamics of the area before any more hunting regulation changes are made.

The first hunting regulation change should be the re-establishment of archery hunting in Hunting District 324. This is proposed to occur during the early archery season in 1988. Weekly flights to locate radio-collared elk and monitor general elk distribution will be attempted during September-November, 1987-90 in and adjacent to this hunting unit. This should help us identify any major distributional changes of elk in response to re-establishing archery hunting in 324.

The first major change in hunting regulations for the rifle season should be made during the 1990 hunting season. Although there are several options, we propose to allow hunting by special permit only during the first and last weeks of the general hunting season in hunting districts 323, 324, 325, 326, 327, and 330 with the middle three weeks open to any elk hunter wanting to shoot a branch-antlered bull. This type of a regulation may allow for better recruitment of bulls into older age classes by protecting them from the large amount of hunting pressure that usually occurs during the first week of the season and when weather usually forces them to concentrate near winter ranges during the last week of the season.

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